Center for Chips with Heterogeneously Integrated Photonics (CHIPS)

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OIDA Review

UCLA UCI

UCSB

Center for Chips with Heterogeneously Integrated Photonics (CHIPS)

PI: Sadik Esener; MDA 972-00-1-0019 start: 7-1-2000

Mission:

- To innovate photonic components beyond classical limits by
  - miniaturization,
  - multidisciplinary research,
  - investigation of new applications and close collaboration with industrial partners
- To prepare and train future OE workforce for the rapidly growing Photonics Industry

Core Areas:

Develop core photonic technologies including

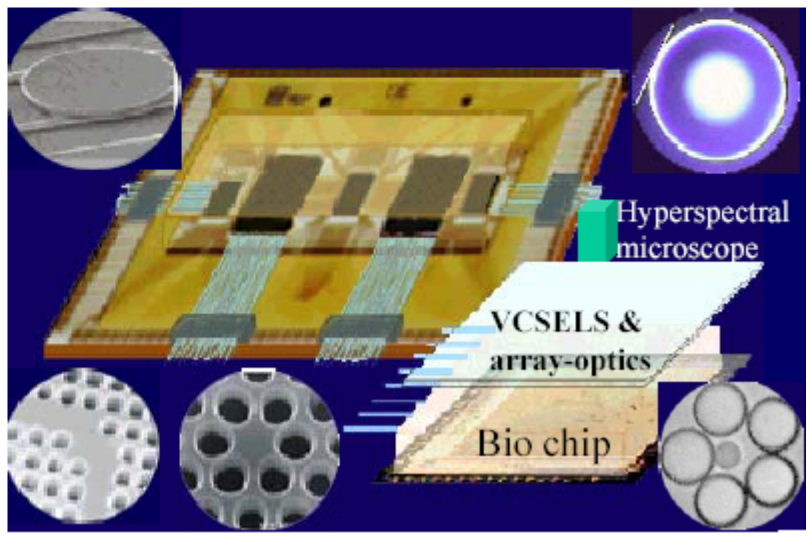
- **Nano, Meso and Near field optics**
- **PBG, and QD lasers**
- **Tunable lasers, detectors, and SOA arrays**
- **Optical μ–beams & fluidics**
- **NOEMS**

for enhancing integration at the device, interconnect, and chip levels for **biochip and photonic switching** applications

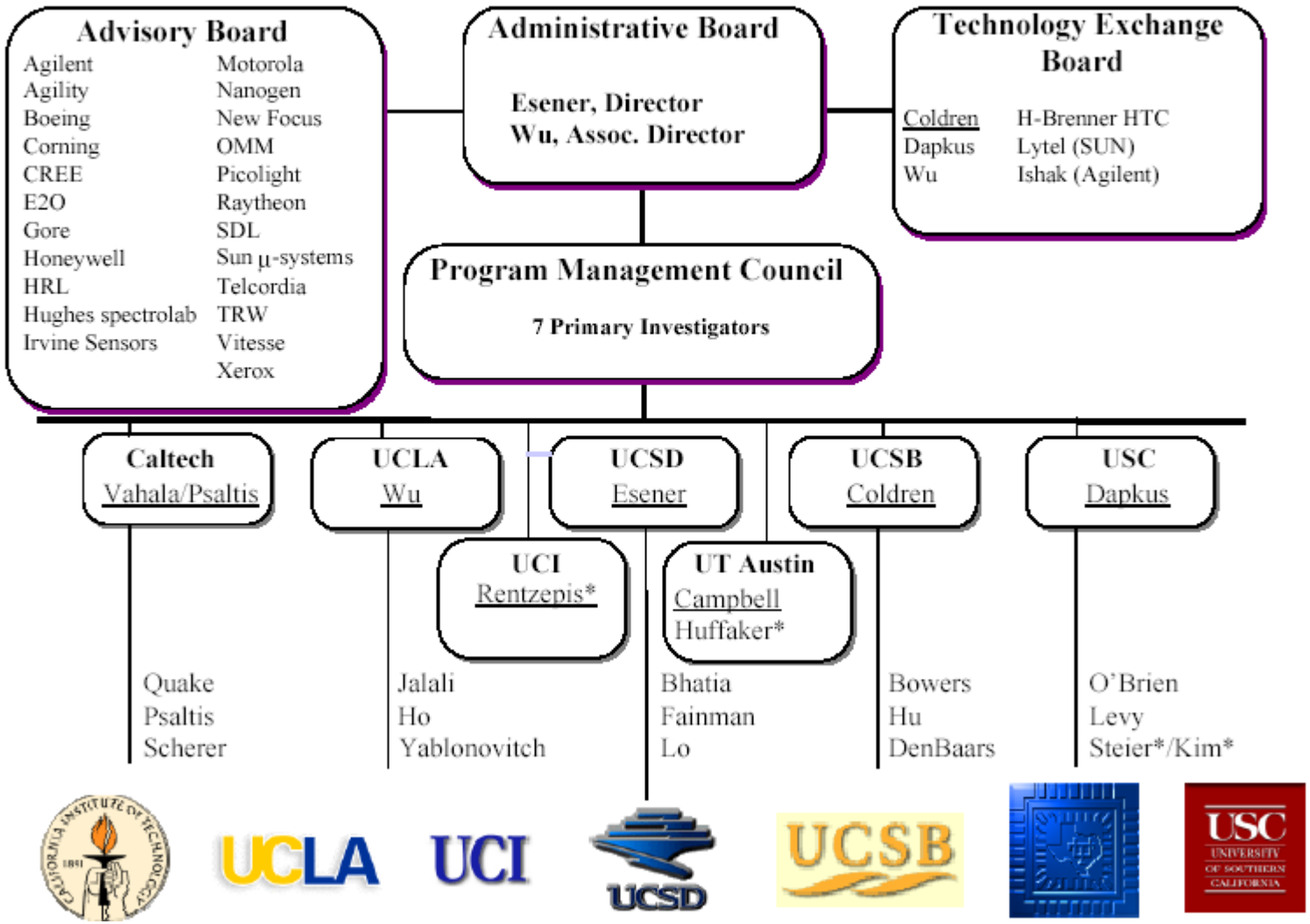
Core Technology Development Thrust

Biophotonic Chip Thrust

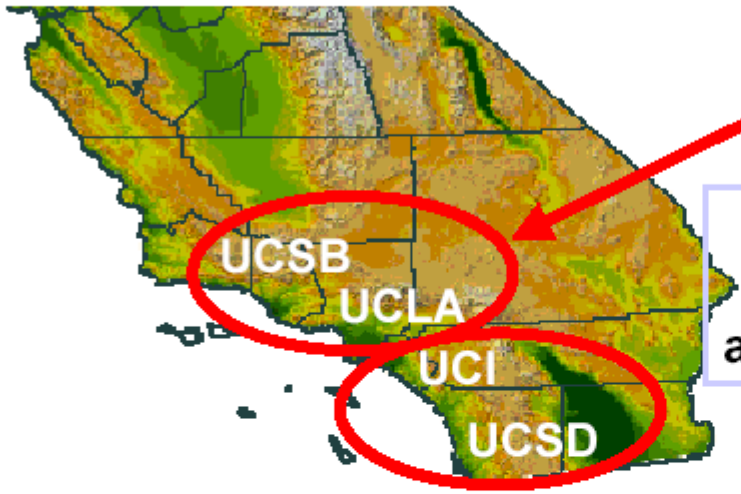
Photonic Switching



CHIPS ORGANIZATION



Strong Interactions with California Institutes for Science, Innovation, and Tech Transfer



The California NanoSystems Institute

The California Institute for Telecommunications and Information Technology

The California Institute for Telecommunications and Information Technology (CAL-IT2 UCSD-UCI)

3x$100M over 5 years ($100M from State)

$140M raised from private sector

$100M from Federal Funding

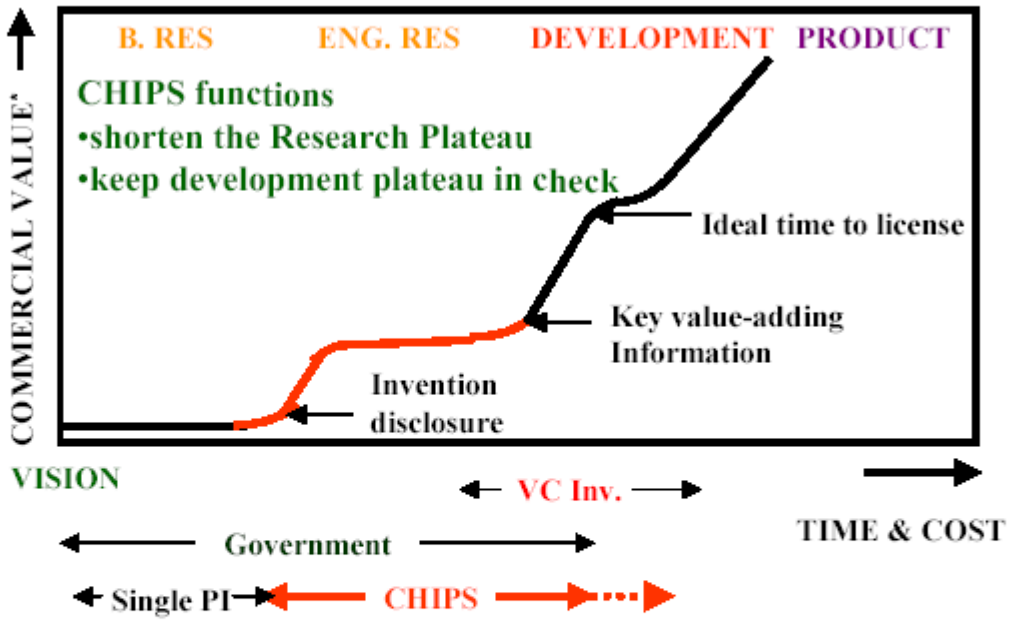
Strong emphasis on Photonics

The California NanoSystems Institute UCSB-UCLA

3X$100M over 5years

Strong Emphasis on Nanotechnology

CHIPS OBJECTIVES & APPROACH



CHIPS OBJECTIVES

Y1&2 Promote Inventions

- Using scaling laws
- Interdisciplinary research

Y3&4 Transition Innovations

- Teaming up with Industry
- New Start-ups

CHIPS APPROACH

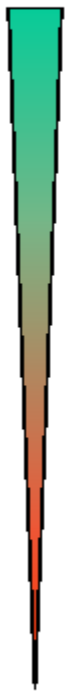
Link

- •Basic science
- •Engineering

- •Corporate R&D
- •Financing

CHIPS WORK AREAS

DARPA SUPPORT



INDUSTRY SUPPORT

Core Technology Development Thrust

- Physics and modeling of nanophotonics
- Materials / Microfabrication / HI
- Light sources and detectors
- Interconnect Components

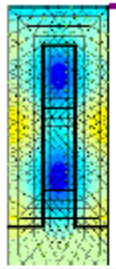
Biophotonic Chip Thrust

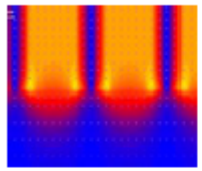
- Microbeam controlled fluidic switch and Pick and Place
- Nanophotonics based bio chemical sensors
- MEMS microspectrometer arrays
- Spectroscopic, confocal and near field two-photon μ-scopes
- System Integration

Photonic Switching

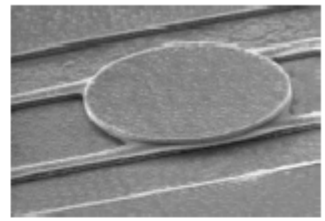
- PBG Switches
- μ-resonator filters, switches and λ-converters
- Polymeric integration for ultra flat optical packages
- System integration on InP

CHIPS Nanophotonics Activities





Model Photonic Crystal and High Q Resonator Devices

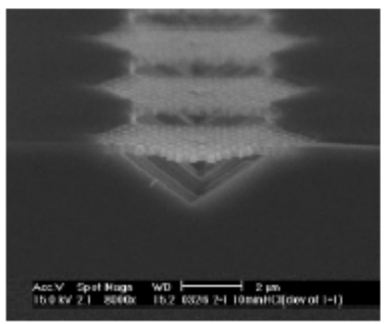


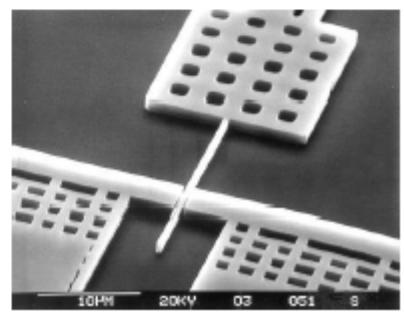
Integrate QD and Resonator Technology

Investigate Fundamental Limits of Nanophotonics Technology

Invent and Demonstrate Nanophotonic Devices with Increased Functionality

Apply Nanophotonic Devices to Biophotonics and Switching





CHIPS Vertical Cavity Device Activities

Importance/Relevance

- **Enable new optical networking architectures**
- **Relevant to datacom & telecom for military & commercial F.O. networks**
- **Industrial participation by Agilent and Honeywell, leveraged by state**
- **Government participation by SPAWAR and ARO/UCSD**

Activities

- **WDM VCSEL Arrays**
  - Wafer-fused
  - Lattice-matched AsSb*
- **VC-SOAs**
  - Wafer-fused, optically pumped
  - Lattice-matched bipolar cascade (tunable)**
- **VC Wavelength-Converting Photon Number Amplifier**
  - Lattice-matched bipolar cascade (tunable)
  - Integration with APDs

Why Biophotonics ?

- On chip Bio-sorters, Bio-sensors, and PCR are key in bio-warfare
  - Photonic arrays provide compact, high throughput solutions

- Healtcare products may dominate the economy of the XXI century
  - Role of Photonics as an enabling technology in this area needs to be investigated

- Biochips need to be disposable and systems must be low cost
  - Biophotonics may be the necessary push to develop mass production technologies for photonic components and systems

- Biologically inspired materials and devices may offer attractive solutions for future photonic components and their integration

CHIPS Biophotonic Activities

Optical manipulation of biological samples
- VCSEL driven arrays of light tweezers

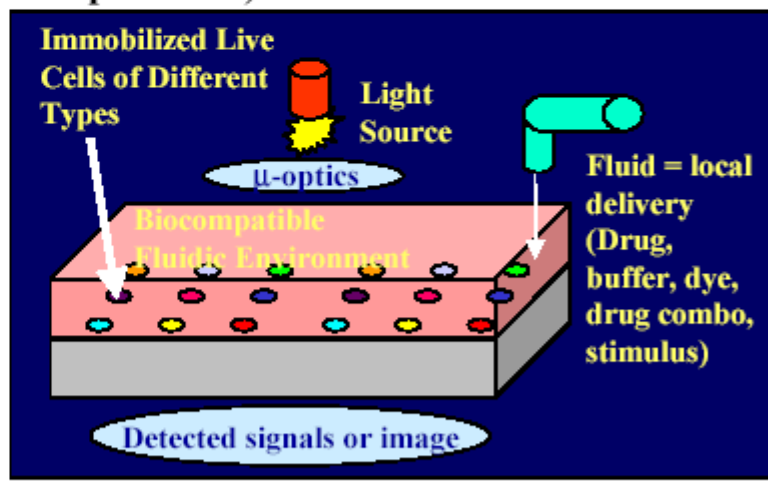
Optical fluidic switching
- Particle switching via VCSEL driven light forces
- Optically switched hydrophobic/hydrophilic fluidic channels

Optical sorting by size and dielectric properties
- Optophoresis- (Transferred to Genoptix Inc.)

Optical fluidic pumps
- Optically activated polymers

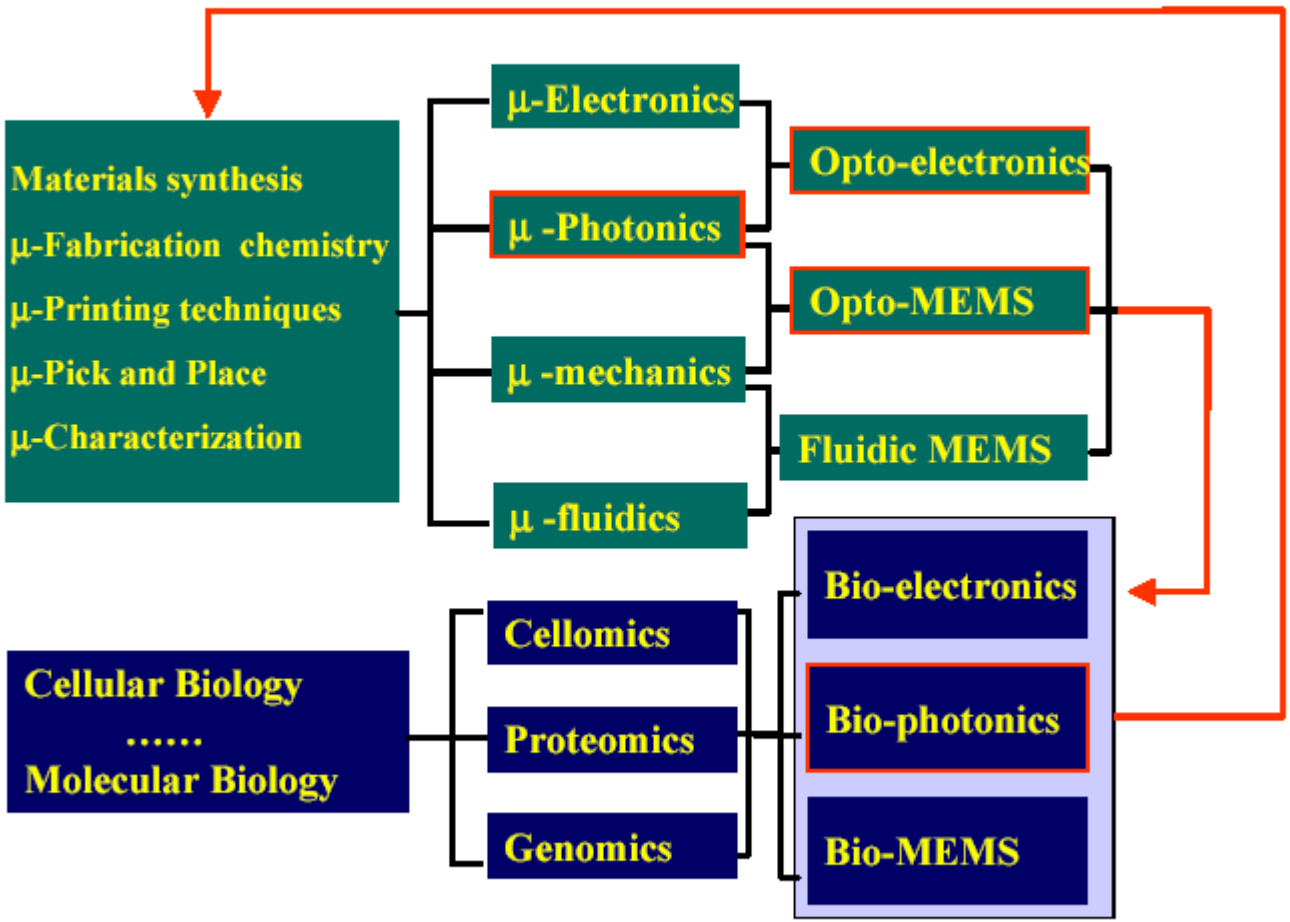
Optical Imaging
- 4-D and near field microscopy

Optical Sensing
- Nanophotonic bio-sensors

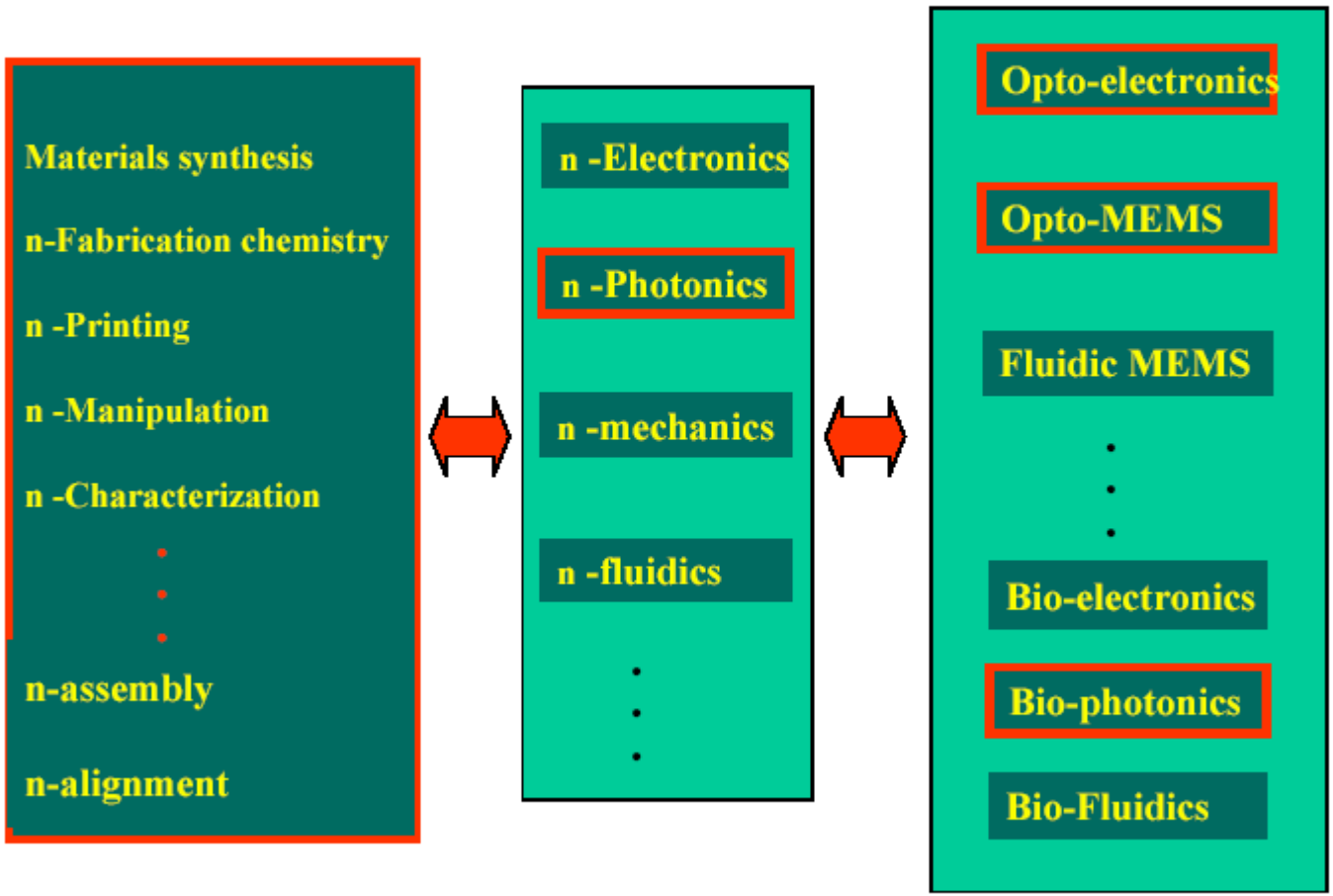


Biologically inspired photonic devices
- Self-aligned/assembled devices
- Biological molecules as tools for heterogeneous integration
- Use of electrophoretic forces for actuation

CHIPS: From the micro to the nano-world



CHIPS: From the micro to the nano-world



Paving the way from the micro to the nano-world